SUPPLEMENTARY DATA ON EXPLOITED STOCKS IN DIVISION 58.5.1 (KERGUELEN)

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Abstract

The results of fishing cruises carried out from 1986/87 to 1988/89 in Division 58.5.1 (Kerguelen Island) have made possible a review of the status of the various harvested fish stocks. Since 1984, an average annual growth of 36% has been noted in the abundance of the juvenile section of the stock of *Notothenia rossii*, a species which is at present only fishable as a by-catch. The total biomass of the stock, however, remains very low according to the assessments carried out by the 1987 and 1988 scientific research cruises. The abundant 1985 cohort of *Champsocephalus gunnari* appeared in the shelf stock and it is from this cohort that the fishery achieved its good results in 1988/89, once the cohort had reached legal catch size. The value of the selected abundance index (catch per unit effort expressed in tonnes per fishing hour) is, however, lower than those observed for the two preceding cohorts (1979 and 1982) in a comparable period. The stock of *Notothenia squamifrons* shows a very low biomass value in 1987 and 1988. After a continuous reduction in average length since the creation of the EEZ, a slight increase has been recorded recently, accompanied by an increase in the abundance index, following a reduction in catch and fishing effort. This trend could well be reversed by too high a catch in 1988/89. Finally, it is not possible to accurately estimate the stock status of *Dissostichus eleginoides* because of the lack of recent fishery data.

Résumé

Les résultats des campagnes de pêche 1986/87 à 1988/89 réalisées dans la division 58.5.1 (îles Kerguelen) ont permis de réexaminer le statut des différents stocks de poissons exploités. Pour *Notothenia rossii*, dont la pêche est désormais limitée aux captures accessoires, un accroissement moyen annuel de 36% est noté pour l'abondance de la partie juvénile du stock depuis 1984. La biomasse totale du stock reste cependant encore très faible d'après les évaluations des campagnes scientifiques 1987 et 1988. La cohorte abondante 1985 de *Champsocephalus gunnari* est apparue pour le stock du plateau et c'est sur cette dernière que la pêcherie a réalisé ses bons résultats 1988/89, une fois que la taille légale de capture ait été atteinte. La valeur de l'indice d'abondance retenu (Capture par Unité d'Effort exprimée en Tonnes par heure de pêche) est cependant plus faible que celles observées pour les deux cohortes précédentes (1979 et 1982) à période comparable. Le stock de *Notothenia squamifrons* présente une valeur de biomasse très faible en 1987 et 1988. Après une diminution continue de la longueur moyenne depuis la création de la ZEE on constate une légère augmentation récente accompagnée de celle de l'indice d'abondance, après réduction de la capture et de l'effort de pêche. Cette tendance risque d'être contrariée par une capture trop élevée en 1988/89. Enfin l'état du stock de *Dissostichus eleginoides* ne peut être évalué correctement en raison de son exploitation récente.

Резюме

В результате промысловых рейсов, выполненных на Участке 58.5.1 (остров Кергелен) с 1986/87 по 1988/89 гг., предоставилась возможность сделать обзор состояния различных облавливаемых рыбных запасов. Начиная с 1984 г. средний темп ежегодного роста неполовозрелой части запаса *Notothenia rossii* составлял 36%, в настоящее время этот вид входит исключительно в состав прилова. Тем не менее, по оценкам, сделанным в ходе научно-исследовательских рейсов 1987 и 1988 гг., общая биомасса этого запаса все еще очень низка. В состав шельфового запаса вошла многочисленная когорта *Chamspocephalus gunnari* 1985 г., за счет этой когорты в течение промыслового периода 1988/89 г., когда она достигла установленного промыслового размера, были достигнуты хорошие результаты. Тем не менее, показатель численности (вылов на единицу промыслового усилия, выраженный в тоннах на час промысла) был ниже показателей численности для двух предыдущих когорт (1979 и 1982 гг.) за подобный период. В 1987 и 1988 гг. уровень биомассы запаса *Notothenia squamifrons* был очень низким.Со времени установления экономической зоны наблюдалось постоянное сокращение средней длины. Тем не менее, за недавнее время, вследствие снижения величины уловов и интенсивности промыслового усилия, было отмечено незначительное увеличение средней длины, на ряду с повышением показателя численности. Однако, эта тендеция может быть заменена противоположной в результате слишком высокого объема вылова за 1988/89 г. В заключение, оценить состояние запаса *Dissistichus eleginoides* точно невозможно в связи с отсутствием промысловых данных за самый недавний период.

Resumen

Los resultados de los cruceros de pesca llevados a cabo desde 1986/87 hasta 1988/89 en la División 58.5.1 (Isla Kerguelen) han hecho posible hacer una revisión de la condiciones de las varias poblaciones de peces. Desde 1984, un crecimiento promedio anual de 36% se ha observado en la abundancia de la sección juvenil de las poblaciones de *Notothenia rossii*, una especie la cual es, al momento, capturada sólo como pesca accidental. La biomasa total de la población, sin embargo, permanece muy baja, de acuerdo a las evaluaciones realizadas por los cruceros de investigación científica de 1987 y 1988. El cohorte abundante de 1985 de *Champsocephalus gunnari* apareció en la población de la plataforma y es de este mismo que la pesquería consiguió sus bueno resultados en 1988/89, una vez que el cohorte alcanzó tamaño de pesca legal. El valor del índice de abundancia seleccionado (esfuerzo de pesca por unidad expresada en toneladas por hora de pesca) es, no obstante, más bajo que aquellos observados en los dos previos cohortes (1979 y 1982) en un período comparable. La población de *Notothenia squamifrons* muestra un valor de biomasa muy bajo en 1987 y 1988. Siguiendo una continua reducción en la longitud promedia desde el establecimiento de la EEZ, un pequeño aumento se ha registrado últimamente, acompañado por un

aumento en el índice de abundancia, después de una reducción en el esfuerzo de pesca y captura. Esta tendencia podría cambiar totalmente si se permite una pesca demasiado alta en 1988/89. Finalmente, es imposible hacer una estimación adecuada sobre la condición de la población de *Dissostichus eleginoides* debido a la carencia de datos recientes de pesca.

1. INTRODUCTION

After two seasons (1986/87 and 1987/88) of small catches (7 910 and 850 tonnes), Division 58.5.1 has recorded in 1988/89 a catch level (26 298 tonnes) comparable to that observed from 1979/80 on, when a system for monitoring the fishery was established.

Recent trends in the fishery are marked by a short fishing campaign in the 1987/88 southern winter (four trawlers having carried out 837 trawls) followed by a complete cessation of fishing only interrupted by a joint franco-soviet assessment cruise in the 1988 southern summer. Fishing effort was only resumed in the 1988/89 southern spring (11 trawlers following each other made 3 602 trawls), finishing in April 1989.

The status of exploited stocks was treated at some length by Duhamel (1987) and since then a biomass assessment has been carried in 1987 and 1988 during a joint cruise (Duhamel, 1988). The aim of this contribution is to present, for each of the exploited stocks, some new data which have been acquired since these works.

2. METHODS

The data are from scientific projects involving surveys of fish stocks carried out on trawlers operating in the fishing areas. They are concerned both with statistical (catch and fishing effort) data obtained by analyzing fishing logs (KERPECHE data bank) and biological data (LFD, age, reproductive status), these latter having been collected according to the recommendations for Southern Ocean species.

3. RESULTS

3.1 *Notothenia rossii*

As in South Georgia, a continued decline in catches of *N. rossii* at Kerguelen has been one of the notable features of trends in this fishery. This species was in fact the main resource when harvesting first began, but now only appears as a secondary species. It must be added that the main work of the Scientific Committee has been concentrated on this species up to now.

At Kerguelen, following the establishment of an Integrated Study Region which in turn followed a decade of unregulated exploitation, a continued decline in the abundance index (average CPUE expressed as tonnes per hour of fishing) was ascertained from 1980 to 1982 (Duhamel, 1987). Directed fishing on the only spawning ground on the southeast of the shelf in the southern winter, which corresponds to the reproductive period, has led to the recommendation of a cessation of this practice. A temporary closure of this fishing area has been in effect since 1984. An assessment of the biomass of individuals aged more than three years present over the Kerguelen Shelf was carried out in 1987 and 1988 (Duhamel, 1988). The results obtained provide a value of between 18 000 and 28 000 tonnes which clearly indicates a significant reduction in the biomass since the commencement of exploitation. Simulation tests on the reconstitution of the stock (Hennemuth et al., 1988) allowed for a forecast on the future of the stock following the implementation of some conservation measures. In particular, a low level of fishing effort would correspond to (be followed by) a doubling of the biomass of the stock in five years.

The implementation of conservation measures does not, however, always allow the recovery of the stock, particularly in the case of *N. rossii*. Outside of the reproductive period the adult stock is very widely dispersed, in very random spatial aggregations, which does not allow the abundance index used to reflect the status of the stock. It is therefore

essential to have recourse to methods which do not introduce a bias. An analysis of the recruitment of juveniles in the coastal area appears therefore to be most appropriate. Regular experimental fishing with trammel nets in this area would thus allow the measurement of variations in the abundance of this part of the stock which remains limited to the relatively shallow waters of the archipelago for the juvenile growth period (Hureau, 1970; Duhamel, 1987). The observed trend will later have repercussions on the adult stock, with some inertia due to growth, taking into account mortality phenomena.

The results obtained since 1982 in the Morbihan Gulf (Figure 1) (Duhamel and Hureau, in press) show a very low abundance of juvenile stock in 1984, which could be correlated with a noticeable decrease in the adult stock prior to that date. In fact a certain displacement between the abundance of the two stocks is observed, taking into account the fact that these are juvenile fish of age classes 2 and 3, and therefore will have hatched from layings of adult stock of three or four years earlier, which are caught in the trammel nets. Then a gradual increase in abundance with an average annual growth rate of 36.3% is observed, which leads to a doubling in the number of individuals in a little less than three years. The growth in the biomass of the juvenile stock is noted and a deferred impact will be observed on the adult stock with a delay of about four years corresponding to the arrival (at the age of 5 to 6 years) of these juveniles on the shelf.

A catch limited to by-catches has recently been initiated for the *N. rossii* stock fished at Kerguelen in order to assist the recovery of the latter. A perceptible reduction in annual catches of this species since that date (1986/87, 481 tonnes; 1987/88, 24 tonnes; 1988/89, 282 tonnes) is thus to be noted and one can hope for a gradual recovery of the adult stock similar to that observed in coastal areas for juveniles, approximating to that in the simulation model.

3.2 *Champsocephalus gunnari*

Icefish constitute the main catch at present on the Kerguelen Shelf since for the 1988/89 season it represented 86.3% of the 26 697 tonnes caught.

Fishing is carried out, for the shelf stock, on a single cohort hatched in 1985 which began to be harvested once the legal size (25 cm) was reached (1988). Regular sampling in the northern and northeastern parts of the shelf (traditional fishing sectors) permitted the growth of the cohort to be surveyed (Figure 2) as had been done for the cohorts 1979 and 1982 (Duhamel, 1987). The average length observed for the 1988/89 season was 29.2 cm which compares closely with previous data on the same growth sampling period. No other abundant cohort has been able to be detected since the southern winter of 1987 which confirms the hypotheses of an abundant recruitment every three years corresponding to the first reproduction of mature individuals in each cohort. The analysis of length frequency distributions provides three other kinds of information useful for the management of the stock.

- The sex ratio is continuously unfavourable to males (only 37.8% are males) but no significant difference in average length between the two sexes has been noted (Figure 3).

- The annual growth period begins in December and continues throughout the summer (Figure 4).

- There were no differences between sampling carried out on catches made by benthic trawl and that made by semipelagic trawl. The same stock is thus being harvested (Figure 5).

The initial biomass of the 1985 cohort was assessed during the 1988 scientific cruise (Duhamel, 1988) and shows a high abundance. Following the 1988/89 fishing season the abundance index (CPUE in terms of the average number of individuals caught per hour of trawling) gives a value of $3.16 .10^4$, which is lower than the values observed, for an equivalent age, for the 1979 (4.40) and 1982 (3.81) cohorts. An analysis of these three values shows a certain trend towards a decrease in the total biomass of each cohort. Some reservations must however be expressed concerning a potential bias due to a change in fishing methods recorded in the past few years (selective use of semipelagic trawls, trawling strategy taking into account nycthemeral migrations of the species, longer trawling times, cessation of fishing at night) which make standardization of the index more difficult. Thus fishing effort for the target species *C. gunnari* in the northern and northeastern sectors during the 1988/89 season can be divided into benthic trawls (62%) and semipelagic trawls (38%) with respective yields of 4.71 and 4.46 tonnes per hour (Table 1).

These results do not bring out the important differences between the two types of fishing gear as was previously the case (Duhamel, 1987).

The second stock of icefish in Division 58.5.1, that of the Skif Bank at the southwest of the shelf, has not been fished, nor sampled, since April 1988, when the 1987 cohort appeared (Lt=13 cm) following the 1984 cohort whose presence was still recorded (Lt = 33.3 cm). The 1987 cohort will reach sexual maturity in 1990, at the same time as it attains its legal fishing size. Previous studies (Duhamel, 1987) have, however, demonstrated that the biomass of this stock is small in relation to the shelf stock and would not sustain a heavy fishing effort.

3.3 *Notothenia squamifrons*

Unlike *C. gunnari*, the sex ratio for *N. squamifrons* is practically even and no difference is observed between average length in samplings carried out on the Kerguelen Shelf stock for both sexes (Lt=33.3 and 33.5 cm in 1988/89) (Figure 6). After a continued decrease in the average length observed between 1983/84 and 1986/87 (Duhamel, 1987) and which carried through into 1987/88 (Lt=30.8 cm), the value observed in 1988/89 is higher (Lt=33.4 cm), very close to average length at sexual maturity (33.5 and 33.8 cm at the age of 9 years). The length frequency distribution observed in 1988/89 is very close to that observed since 1985/86 with a demographic structure of the exploited population comprising mainly individuals aged between 7 and 11 years.

The biomass of the shelf population was considered to be very low in 1987 and 1988 (between 5 500 and 9 000 tonnes) (Duhamel, 1988) which corroborates/confirms the results of the virtual population analysis (Duhamel, 1987). Catches of *N. squamifrons* were insignificant in 1987/88 (41 tonnes) but in 1988/89 they exceeded (1 825 tonnes) the values recorded in 1986/87 (1 641 tonnes). Values of the abundance index (CPUE in t/h) recorded in 1986/87 in the southern (1.58) and southeastern (0.68) sectors confirm the trend towards a decrease in the biomass, however in 1988/89 there is a certain slowing of the trend in the southern sector (1.38) and a further increase in the southeastern sector (1.08) (Figure 7). Considering this analysis in terms of the annual area of distribution of the stock, this recovery, if noted, is very small. It therefore seems that the effect of a temporary cessation of fishing in 1987/88 has been weakened in 1988/89 by a fishing effort too great for this fragile stock.

A second stock of *N. squamifrons* exists on the Kerguelen-Heard Banks at the border of Divisions 58.5.1 and 58.5.2, and sampling carried out in 1979 and since 1987 prove that the demographic structure observed is close to that of an unexploited population (Lt=43.0 cm in 1989). Some catches of this small stock (138 tonnes in March 1989) have

to be remarked on. The lack of regular observations does not allow an evaluation of the size of this resource, which must be limited because of the small size of the available areas, to be made at present.

3.4 *Dissostichus eleginoides*

During the 1984/85 fishing season, a stock of adult *D. eleginoides* was discovered in a deep area of the western sector of the Kerguelen Shelf. Since that date, this sector has become the most exploited sector for the catch of this large-sized species. Fishing effort on this new target species has however fluctuated greatly from one year to the next (Table 2) in relation to the availability of other exploited species, particularly icefish. The fishing season is largely concentrated within the months of October and January and average yields observed (Table 3) are at present (1.96 t/h in 1988/89) greater than those for *N. squamifrons* (1.19 t/h in 1988/89), which is remarkable considering the difficulties encountered in fishing for this species, but do not, however, reach the levels observed for *C. gunnari* (4.46 t/h in 1988/89). It would be premature to assess the status of the exploited stock especially since trends in the abundance index fluctuate greatly and knowledge of the biology of the adults is still very incomplete.

4. CONCLUSION

The status of exploited stocks at Kerguelen requires a regular and continuing survey allowing for the modification of catch sizes and conservation measures in force. The *N. rossii* stock will require maximal protection as long as the biomass of the adult stock fails to increase significantly. Fishing effort on the *C. gunnari* stock should take account of the three-year cycle which has now been revealed, and catch levels should be based on a measurement of the recruitment of each new cohort before it begins to be exploited. The *N. squamifrons* stock is at present being over-exploited and conservation measures should be implemented in order to reverse this. Finally, it is too early to assess the status of the stock of *D. eleginoides*.

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Table 1: Fishing effort, catch and corresponding mean yield for the exploited *Champsocephalus gunnari* stock in the northern to northeastern part of the Kerguelen Shelf in 1988/89.

Semipelagic trawls:	Effort (hours of fishing):	1 896
	Catch (tonnes):	8 923
	Yield (t/h):	4.71
Benthic trawls :	Effort (''):	3 069
	Catch (''):	13 679
	Yield (''):	4.46

Table 2: Fishing effort, catch and corresponding yield for the stock of *Dissostichus eleginoides* harvested in the west of the Kerguelen Island Shelf from 1984/85 to 1988/89.

Fishing season	Fishing effort (hours of fishing)	Catch (tonnes)	Yield (t/h)
1984/85	2 597	6 492	2.50
1985/86	263	370	1.41
1986/87	1 779	3 190	1.79
1987/88	637	497	0.78
1988/89	907	1 496	1.64

Table 3: Fishing effort, catch and yield for the stock of *Dissostichus eleginoides* harvested in the western sector of the Kerguelen Shelf in the southern spring from 1984/85 to 1988/89.

Fishing season	Fishing effort (hours of fishing)	Catch (tonnes)	Yield (t/h)
1984/85	2 026	5 979	2.95
1985/86	263	361	1.37
1986/87	1 756	3 158	1.80
1987/88	(58)	(36)	- . - -
1988/89	655	1 286	1.96

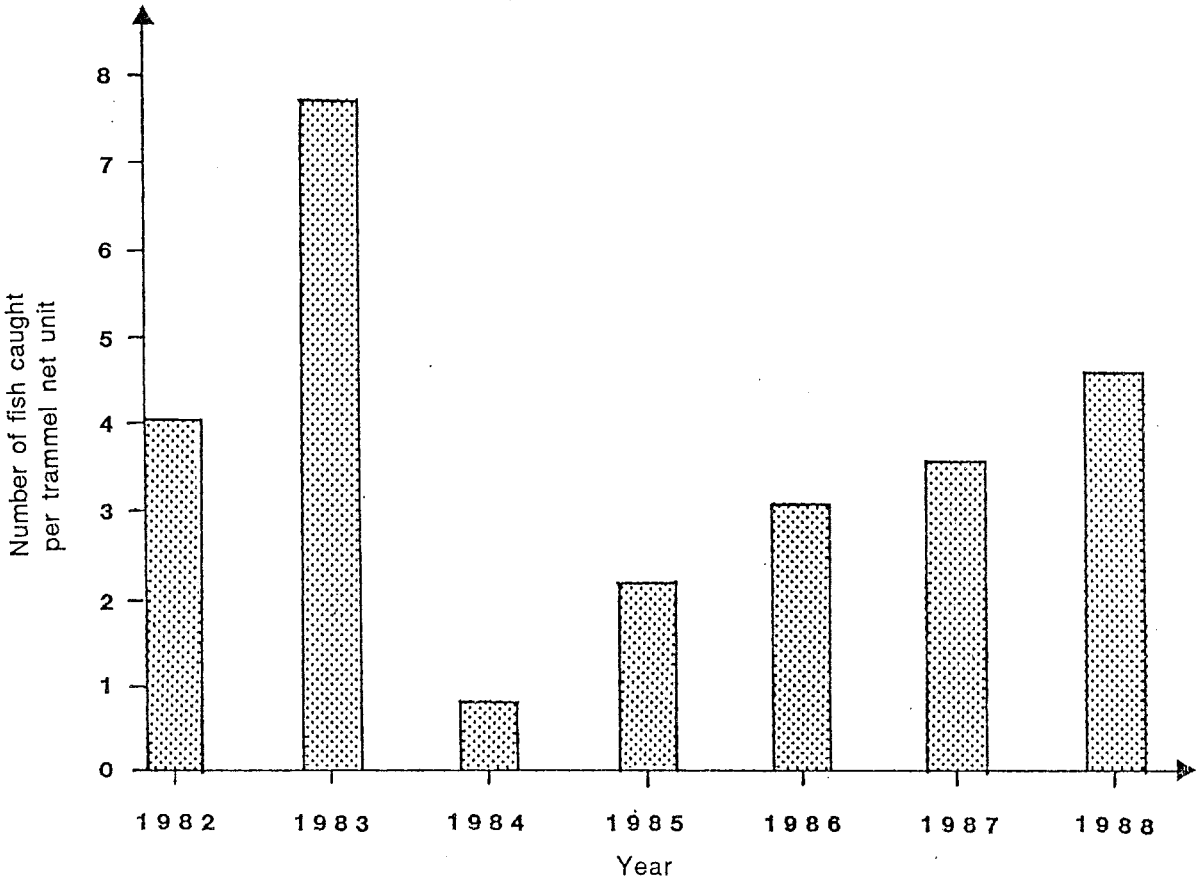

Figure 1: Mean annual abundance (expressed as the number of fish caught per unit trammel net) of juvenile *Notothenia rossii* in the Morbihan Gulf, a coastal area of the Kerguelen Islands, from 1982 to 1988.

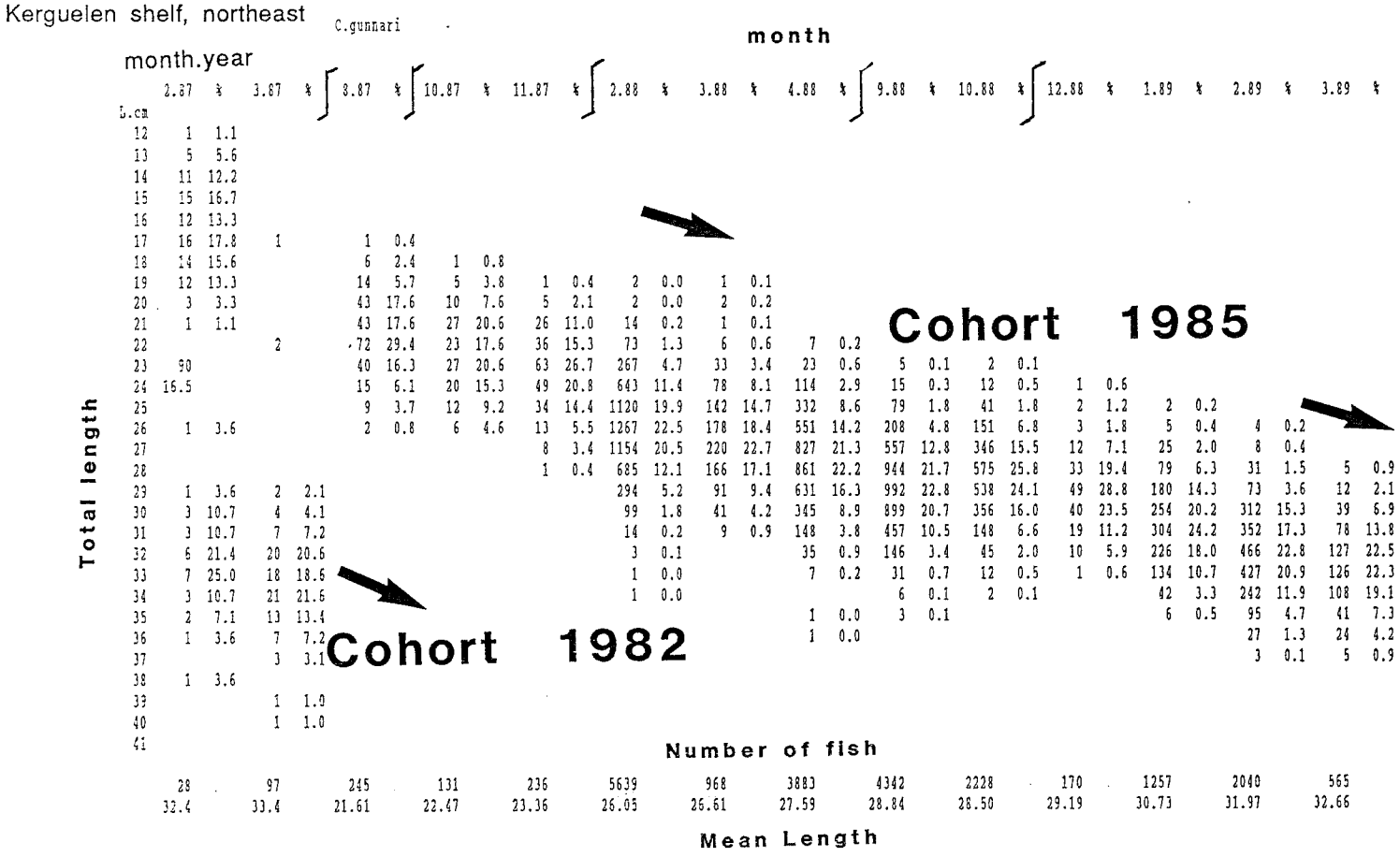

Figure 2: Length frequency distributions (LFD) of *Champsocephalus gunnari* obtained by monthly sampling in the northeastern zone of the Kerguelen Islands from 1987 to 1989.

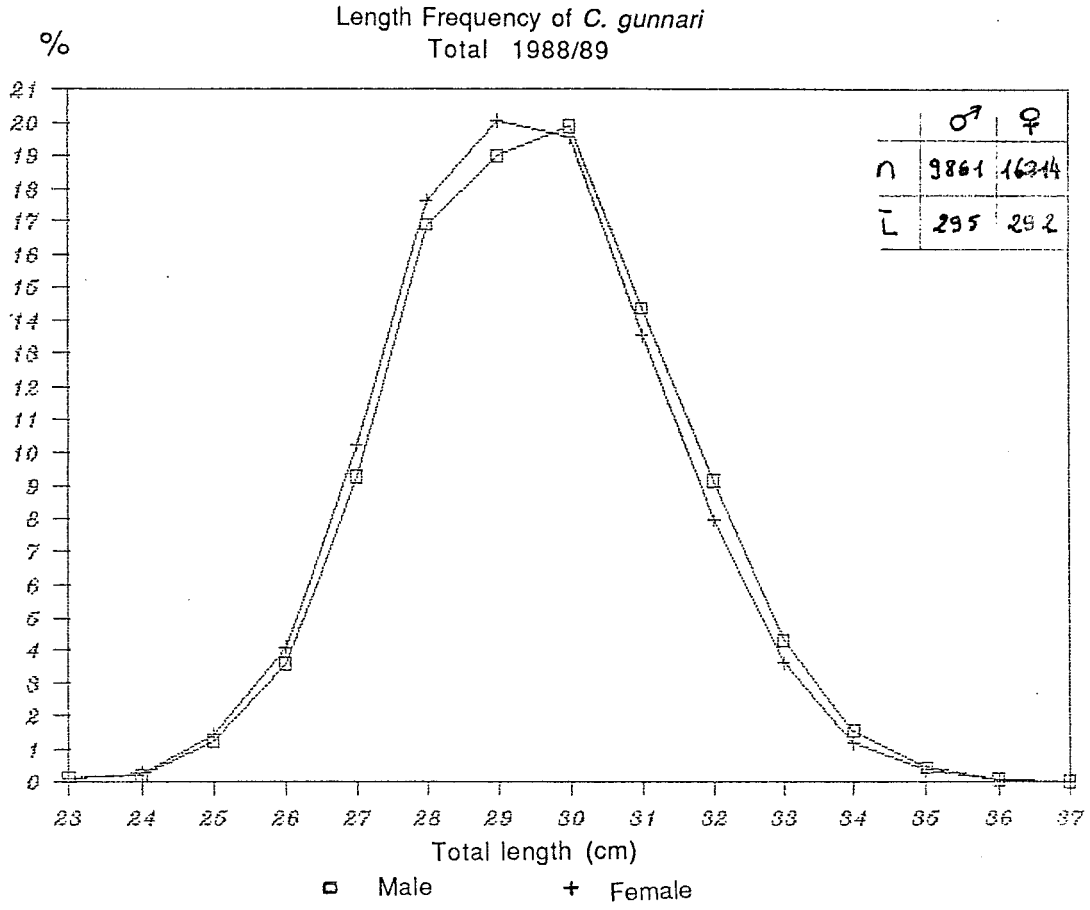

Figure 3: Length frequency distributions (LFD) of male and female *Champsocephalus gunnari* obtained in 1988/89 on the Kerguelen Shelf.

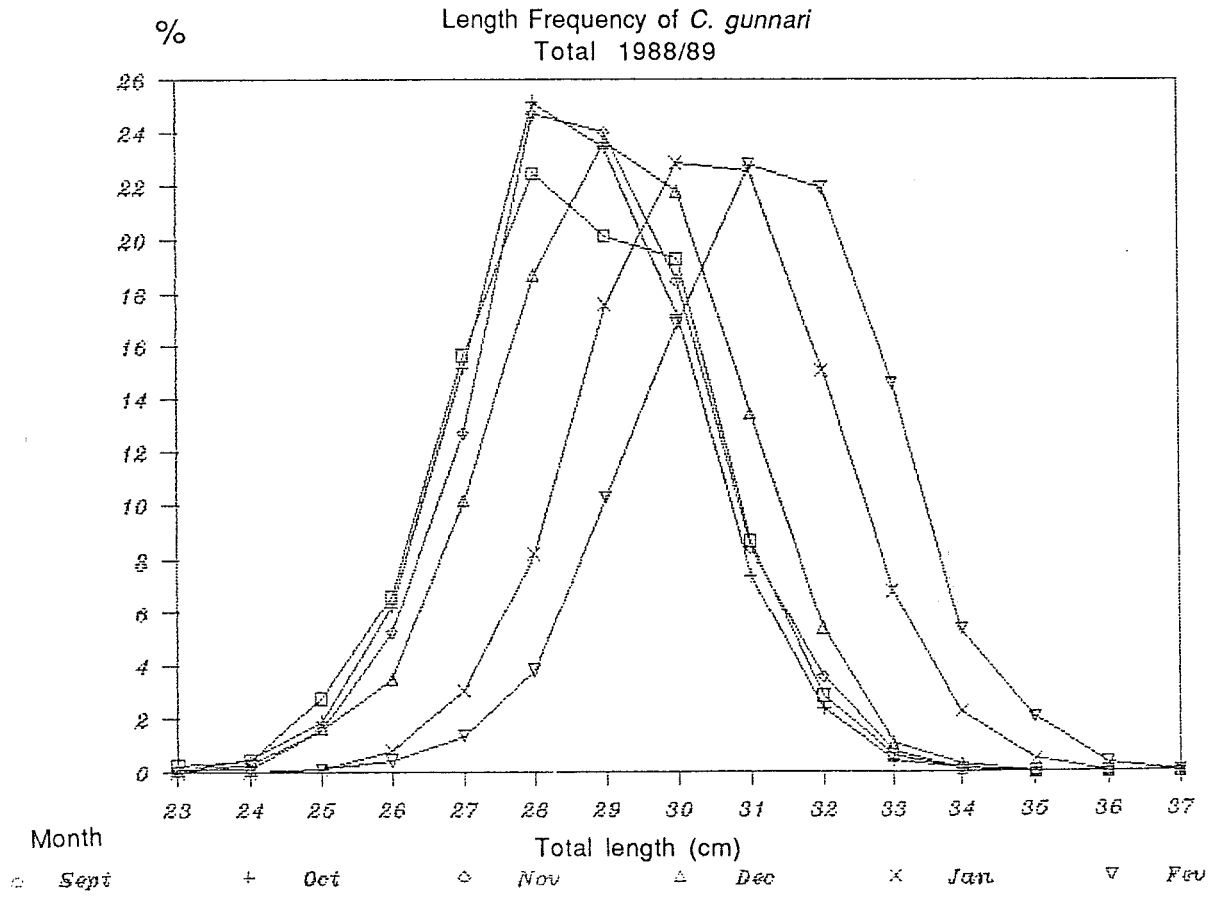

Figure 4: Length frequency distributions (LFD) of *Champsocephalus gunnari* obtained on a monthly basis on the Kerguelen Shelf in 1988/89.

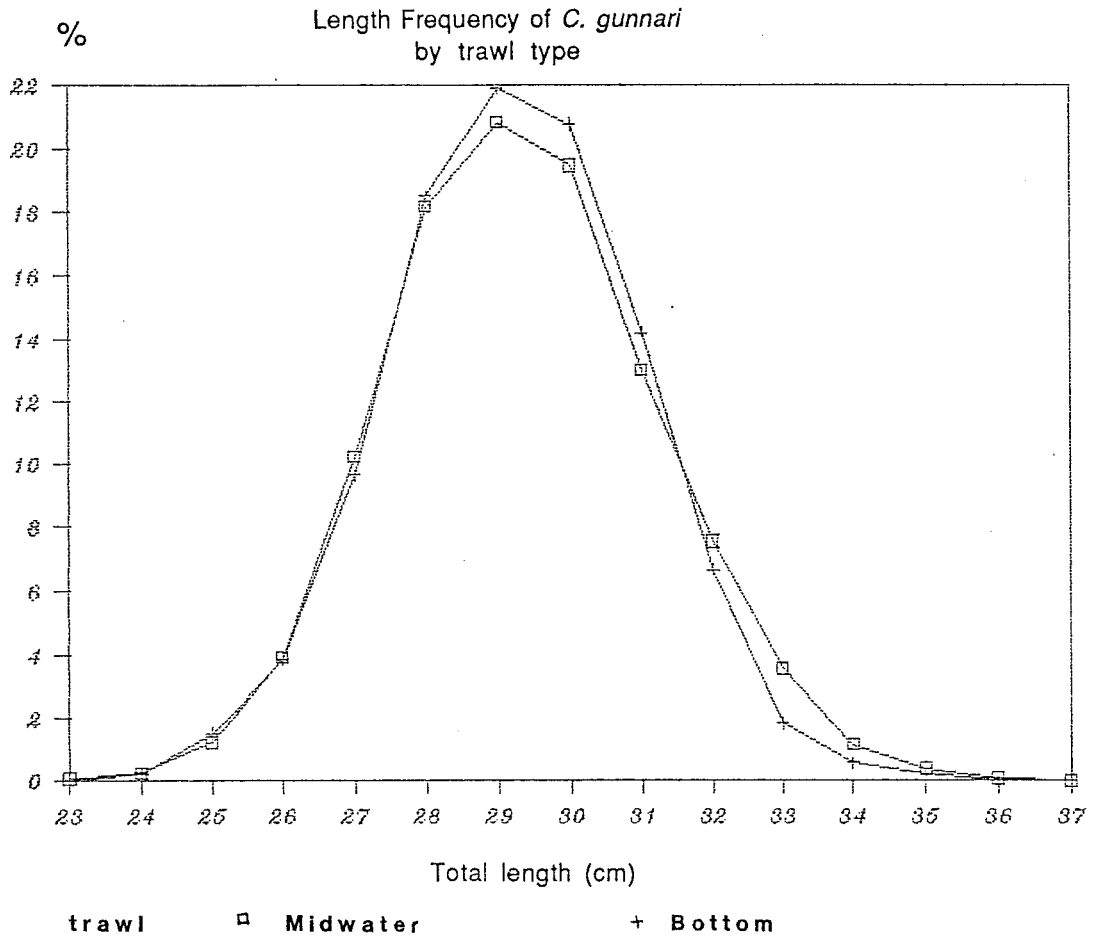

Figure 5: Length frequency distributions (LFD) of *Champsocephalus gunnari* obtained from sampling of catches made by semi-pelagic and benthic trawl in 1988/89.

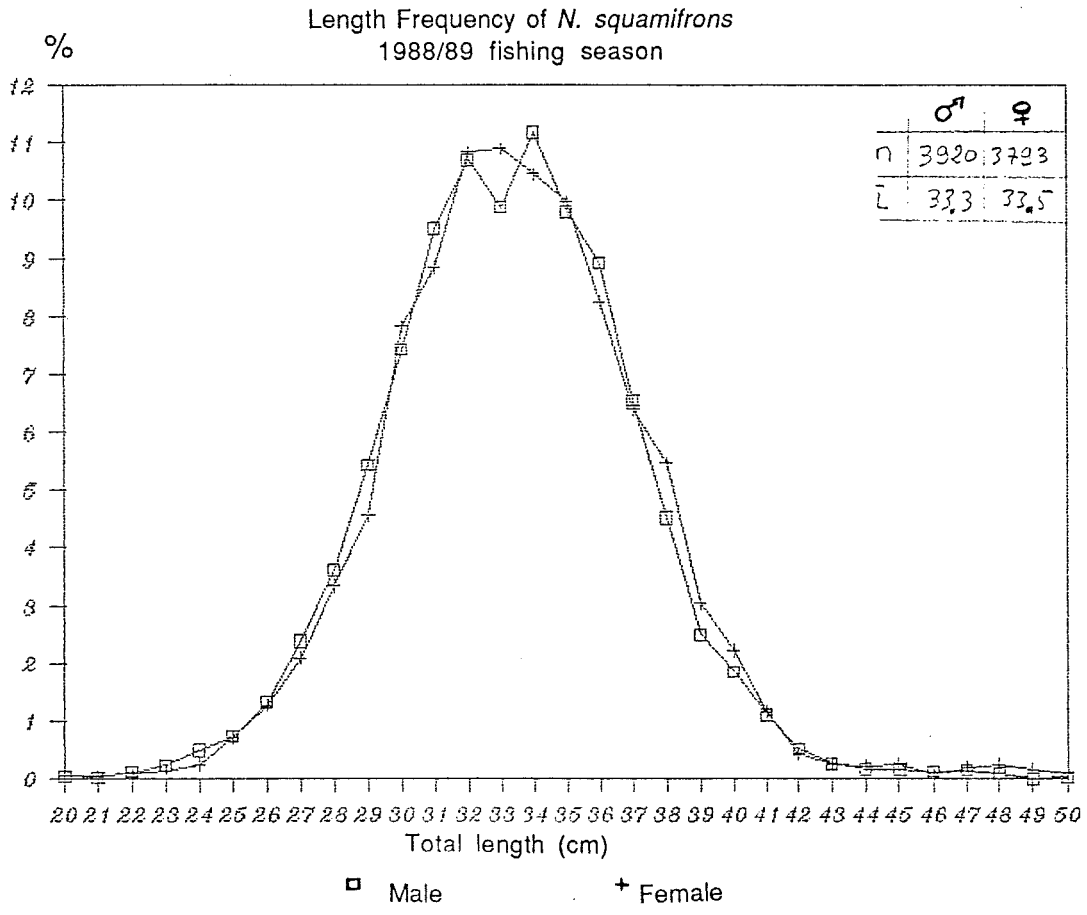

Figure 6: Length frequency distributions (LFD) of male and female *Notothenia squamifrons* obtained during sampling in 1988/89.

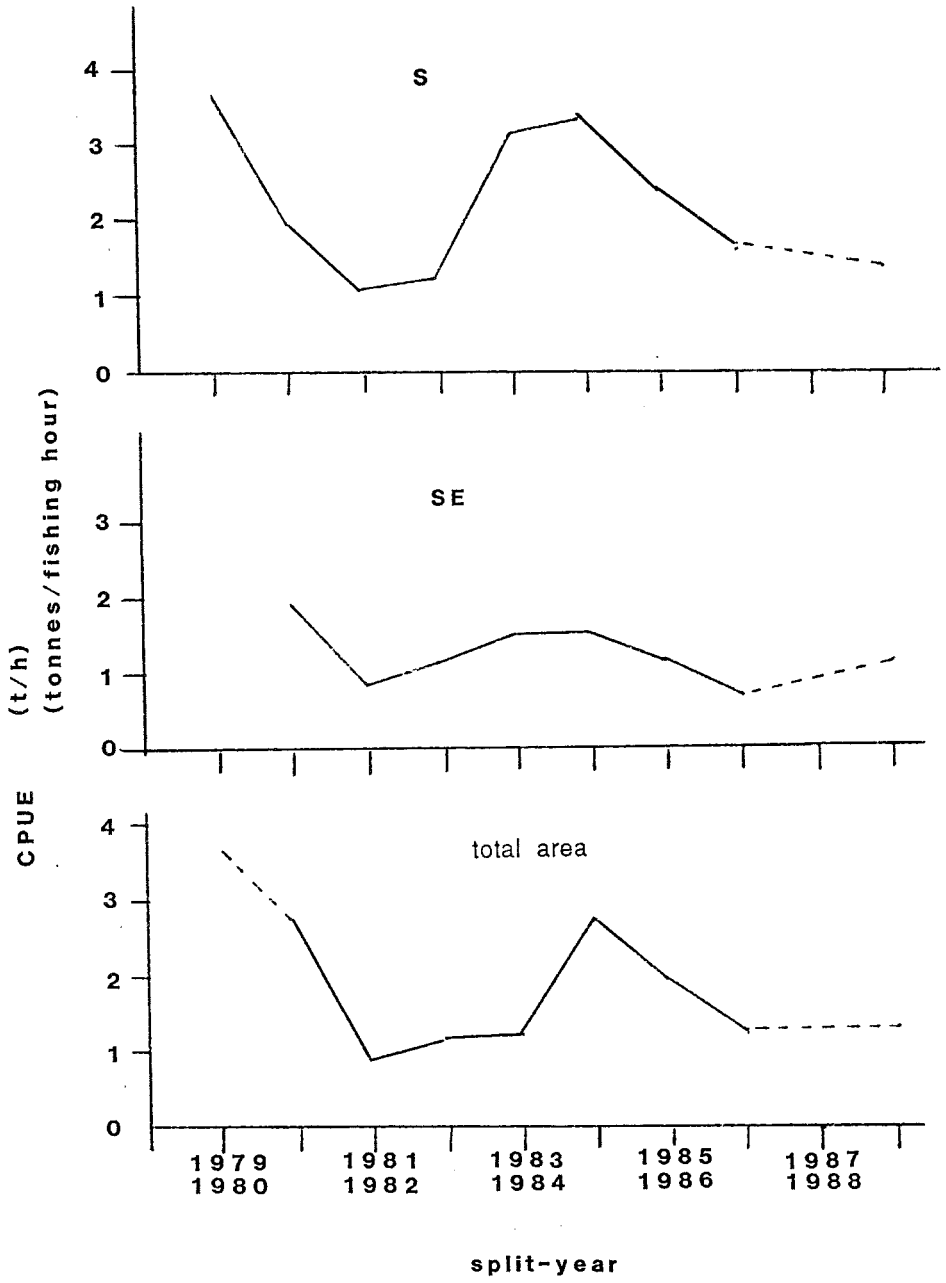

Figure 7: Variation in the abundance index (expressed as tonnes of fish caught per hour of trawling) for the exploited stock of *Notothenia squamifrons* from the Kerguelen Shelf from 1979/80 to 1988/89.

S: Southern sector SE: Southeastern sector